LOCAL TOPOGRAPHY AND AREAL DISTRIBUTION OF BRIGHT AND DARK MATERIAL ON GANYMEDE. B. Giese[1], J. Oberst[1], B. Schreiner[1], T. Roatsch[1], A.C. Cook[1], G. Neukum[1], J. Head[2], R. Pappalardo[2], and the Galileo Imaging Team [1]DLR, Institute of Planetary Exploration; Rudower Chaussee 5; D-12489 Berlin, Germany; giese@terra.pe.ba.dlr.de, [2]Brown University, Providence, RI, USA.

Introduction

The Galileo SSI camera acquired high resolution (< 100m/pixel) images in Ganymede's Galileo Regio and Uruk Sulcus region during the encounters in June (G1) and September (G2) 1996. The overlapping images were taken at nearly identical solar illumination and from camera positions separated enough for good stereo geometry. This allowed us to perform a photogrammetric analysis of these image data and to derive Digital Terrain Models (DTMs) and orthoimages (images rectified based on DTM information) in the covered regions. Terrain and image data in combination give us the opportunity to study photometric properties of the surface and the spatial distribution of dark and bright terrain material in its relationship to topographic elevation.

Photogrammetric Analysis

In the first processing step the camera pointing data were adjusted based on hand-picked conjugate image points and fixed spacecraft position data. In the second step, dense grids of conjugate image points were determined using methods of digital image correlation ("image matching"). Ray intersection methods were used to calculate ground point coordinates from these. Ground points were converted to a sinusoidal map projection and interpolated to form a contiguous DTM grid. For the image matching, we used patch sizes (correlation windows) of 15 pixels to cope with strong compression artifacts in the G2-images. Orthoimages were derived from each of the stereo partner images using the same map projection types and scales as for the DTM. In order to study the importance of photometric effects in images, Lambertian and lunar-Lambert shading was applied to the DTMs for comparison with the orthoimages.

Results

The terrain models obtained for Ganymede cover an area of 22km x 30km (Uruk Sulcus) (Fig. 1) and 63km x 102 km (Galileo Regio) (Fig. 2), and have spatial resolutions of 200m/pixel and 300m/pixel, respectively. Both models have similar characteristic height ranges on the order of 1km. The spatial resolution of these models is by a factor of three poorer than the resolution of the images, due to limitations of the digital image correlation approach. All heights in the terrain models are relative heights because no ground control information were available.

The Uruk Sulcus terrain (Fig. 1) shows distinct large-scale grooves and ridges aligned with visible dark and bright surface lineaments. A comparison of the shaded DTM with the orthoimage data lead us to conclude that these visible brightness variations are not mainly photometric effects, but rather due to albedo variations, i.e. prevalence of bright and dark surface material. We selected corresponding profiles from orthoimages and the DTM perpendicular to visible surface lineaments in order to directly compare height and brightness variations along these profiles. For Uruk Sulcus, long-wavelength peaks in image brightness appear to correlate well with topographic elevation. Short-wavelength lineaments are not sufficiently resolved in the terrain model. The darker material seems to have accumulated in topographic lows, whereas bright material appears to be located on higher-elevation ridges. In Galileo Regio, it appears that, in addition, bright material is preferrably located at slopes facing to the north and west. This strong correlation of elevation with albedo may hold information on the processes that have formed Ganymede's terrain types and needs to be further explored.

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Fig. 1: Ganymede: Uruk Sulcus perspective view

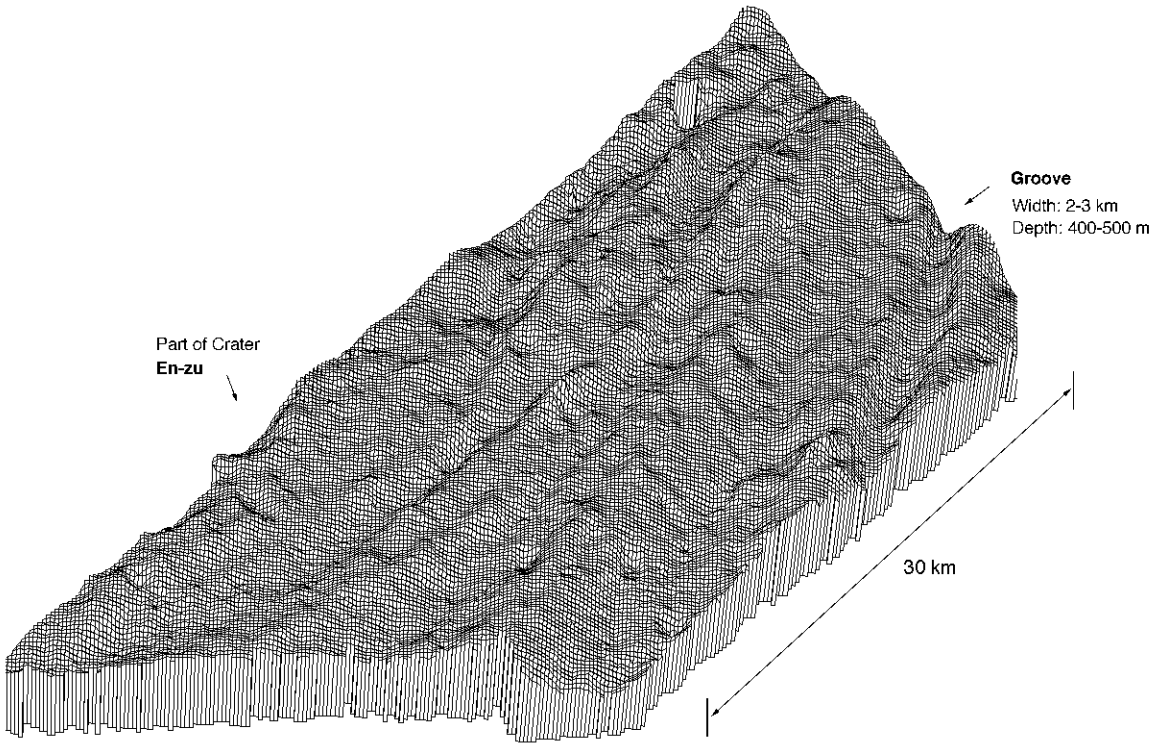

Fig. 2: Ganymede: Galileo Regio perspective view